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AN APPRAISAL OF INSTRUCTIONAL UNITS TO ENHANCE STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES. RESEARCH SERIES IN AGRICULTURAL EDUCATION.

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TWENTY-TWO SELECTED OHIO VOCATIONAL AGRICULTURE TEACHERS AND 262 JUNIOR AND SENIOR VOCATIONAL AGRICULTURE STUDENTS PARTICIPATED IN A STUDY TO MEASURE THE RELATIVE EFFECTIVENESS OF NEWLY DEVELOPED INSTRUCTIONAL UNITS DESIGNED TO ENHANCE STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES IN FARM MANAGEMENT. FARM MANAGEMENT WAS TAUGHT IN THE TRADITIONAL MANNER IN THE CONTROL GROUP OF SIX SCHOOLS. THE NEWLY DEVELOPED INSTRUCTIONAL UNITS WERE USED IN AN UNINTERRUPTED SEQUENCE OF APPROXIMATELY 6 WEEKS IN THE SEVEN SCHOOLS SERVING AS A PILOT-BLOCK GROUP, ANDTHE SAME MATERIAL INTEGRATED WITH OTHER SUBJECT MATTER WAS USED IN NINE SCHOOLS DESIGNATED AS THE PILOT-INTEGRATED GROUP. THE PILOT-BLOCK GROUP OF STUDENTS OBTAINED THE HIGHEST SCORES ON THE POSTTEST WHICH MEASURED THE UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES, FOLLOWED BY THE PILOT-INTEGRATED AND CONTROL GROUPS. OF 13 VARIABLES STUDIED, ONLY FOUR WERE SIGNIFICANTLY ASSOCIATED WITH AN UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES--STUDENT YEAR IN VOCATIONAL AGRICULTURE, STUDENT YEARS OF FARM EXPERIENCE, STUDENT I.Q., AND NUMBER OF TEACHERS IN THE VOCATIONAL AGRICULTURE DEPARTMENT. THE PILOT TEACHERS WERE STRONGLY IN FAVOR OF USING THE DEVELOPED INSTRUCTIONAL UNITS AND FOUND THEM CHALLENGING, TIME CONSUMING, AND REQUIRING EXTRA PREPARATION, BUT THE EXTRA EFFORTS REQUIRED TENDED TO RESULT IN GREATER STUDENT INTEREST AND ACHIEVEMENT. IT WAS RECOMMENDED THAT THE INSTRUCTIONAL UNITS BE REVISED, BASED ON THE FINDINGS OF THIS STUDY, AND USED WITH A LARGER STUDENT SAMPLE SELECTED AT RANDOM THROUGHOUT THE STATE. THE APPENDIXES CONTAIN A BIBLIOGRAPHY AND POSTTEST SCORES FOR ALL PARTICIPATING SCHOOLS. THIS IS A DIGEST OF A PH.D. DISSERTATION. THE COMPLETE STUDY IS AVAILABLE AS VT 004 154. (WB)

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A Research Report
of a
Graduate Study

AN APPRAISAL OF INSTRUCTIONAL UNITS TO ENHANCE STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES

Richard L. Barker and Ralph E. Bender

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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FOREWORD

This is a digest of a Ph.D. dissertation whereby newly developed instructional units were evaluated. The units represent a thrust in the direction of upgrading the curriculum of vocational agriculture to include indepth training by emphasizing the understanding of basic principles. The instructional units concentrated upon economic principles applicable to high school farm management instruction serving as a central core to this vital phase of vocational agriculture training. The units were designed and developed by the Department of Agricultural Education, The Ohio State University.

Excerpts from the original manuscript herein include the purpose and procedures used, and the rationale behind the development of the units; the inductive process of learning and the principles approach to teaching vocational agriculture. Findings of this research are presented giving an indication of the values of this new approach of teaching farm management to high school students.

The instructional units have been revised in light of the field trial and the advise of teachers, teacher trainers, and state supervisors of vocational agriculture. They are available and may be obtained from this department.

Ralph E. Bender

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AN APPRAISAL OF INSTRUCTIONAL UNITS TO ENHANCE STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES

The Problem and Its Setting

American agriculture is undergoing accelerated changes due to socio-economic, scientific, and technological developments. While the number of farms and farm workers has decreased, size of operations and production per acre have increased. Greater capital requirements, narrowing profit margins, and inefficient allocation of production resources continually challenge the farmer in the understanding of the American agricultural economy. These changes have forced agricultural educators to adjust the vocational agriculture program to meet the educational needs of students bound for the technical and scientific world of agriculture. Teachers are becoming cognizant of the pressing need for improvements in teaching techniques. They realize that as a result of the rapid changes in modern agriculture the rote memoraization of specific facts has become obsolete since today's facts soon become tomorrow's history.

Until recently, agricultural educators have focused their teaching on factors of production practices and procedures. More attention has been given to production per acre of farm land than to maximum returns per acre through alternative decisions. Today's economy forces the farmer to make logical, well-planned decisions

based on known profit-maximizing principles of farm management.

Duis states that

> One of the biggest problems confronting today's farmer is how to efficiently organize and use resources available to him. He need no longer farm by chance. Through efficient management, farming has become an exacting science and the desired income can be budgeted ahead of time and almost assured. Farming involves tremendous amounts of decision-making. Right decisions result in a good chance of making money while wrong decisions lead to failure.[1]

It is apparent that agricultural education should provide an increased emphasis in training for greater understanding of efficient farm management principles. The high school student must be able to realize the "why" in agricultural decision-making. Many of these decisions, if properly made, could strengthen profits for a sometimes economically depressed segment of American economy. Through greater understanding of economic principles, low-income families as well as all families could greatly improve their economic and productive status.

Teachers of agriculture have generally found farm management a dull subject to teach. Student interest and motivation appear to be lacking partly because of his not yet being in a decision-making setting. The lack of adequate textbooks and teaching materials on the high school level which deal with basic economic concepts has impaired training for entrepreneurship. In answer to a question in Nevada as to why teachers of vocational agriculture did a sporadic or

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[1]Harold F. Duis, "A New Approach to Teaching Farm Management is Necessary," The Agricultural Education Magazine (September, 1963), p. 51.

partial job in providing organized instruction in farm management, Christensen found teachers to state the following:

> Hard to motivate students! Hard to teach.
>
> Cost studies and usable information that applies to the local situation are not available.
>
> Good teaching outlines are not available.
>
> I don't know enough about it to teach it.
>
> Many teachers lack adequate training and preparation in farm management; therefore, the instruction in this important area is neglected.[2]

The responses above are not unlike those expressed by teachers of vocational agriculture in Ohio in 1966. Selected teachers were asked why they were interested in the profit-maximizing principles research project. The consensus of this group was that they were doing an ineffective job of teaching this important phase of the vocational agriculture curriculum and were looking for assistance on how to improve. They found farm management uninteresting to both themselves and to their students. They felt a real need for a central core to their instruction to make it more meaningful and useful for the student in training him in basic agricultural decision-making.

As educators in agriculture look forward in search of improvements, changes must be made and new direction given to farm management instruction in vocational agriculture. Duis writes that "the production approach in teaching farmers must give way to the management

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[2]Howard Christensen, "A Contest Aids in Teaching Farm Management in Nevada," The Agricultural Education Magazine (September, 1963), p. 56.

approach. . . . Teaching of farm management in vocational agriculture is not new but the approach or method must be."[3] Thus, this study, based on seven profit-maximizing principles identified by McCormick,[4] involves the appraisal of a new approach to farm management instruction for students of vocational agriculture in Ohio.

Principles used

DIMINISHING PHYSICAL RETURNS:

The application of additional units of variable resources to a unit of fixed resource increases total output but, after a certain point, the amount added to total output by each successive unit of variable resource diminishes.

DIMINISHING ECONOMIC RETURNS:

After a certain point, the economic returns for each successive unit of variable resource added to a unit of fixed resource tends to decline. However, the farm manager, in order to secure maximum profits, should continue adding variable resources to fixed resources as long as marginal returns are greater than marginal costs.

FIXED-VARIABLE COSTS:

The cost per unit of production can be decreased by spreading fixed costs over more units of production. Therefore, the farm manager should continue using more resources, if capital is available, to increase production as long as variable costs are covered by the marginal returns.

SUBSTITUTION:

When two or more types of resource inputs can be used to produce a given amount of output, the value of the

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[3] Duis, op. cit.

[4] Floyd G. McCormick, "The Development of an Instrument for Measuring the Understanding of Profit-Maximizing Principles" (unpublished Ph.D. dissertation, The Ohio State University, 1964).

resource replaced or displaced by another resource should be greater than the value of the resource added if the farm manager is to secure maximum profits.

OPPORTUNITY COSTS:

The profit of a farm business will be greatest if each unit of land, labor, and capital is used where it will add the greatest marginal returns to the farm business; thus, the farm manager cannot change the distribution of a single unit of variable resource input without reducing farm income.

COMBINATION OF ENTERPRISES:

The best combination of enterprises is where a farm business is so organized that the farm manager cannot add to or expand the size of one enterprise or delete or contract another enterprise without reducing income of the farm business.

TIME RELATIONSHIPS (TIME COMPARISON):

Before investing limited capital resources in the farm business, the farm manager should determine the present value of future income in order to make comparisons between alternatives over time; that is, determine the economic feasibility of making capital investments in the present to obtain income in the future.

Statement of the Problem

The problem involved in this study was one of measuring the relative effectiveness of instructional units designed to enhance student understanding of profit-maximizing principles when used in classes of vocational agriculture.

Specific Objectives

The following specific objectives facilitated the pursuit of this study:

1. To determine what technique of instruction results in the greatest level of student understanding of profit-maximizing principles.

2. To determine the relationship between student understanding of profit-maximizing principles and the following independent variables:

   a. Student year in vocational agriculture

   b. Student year in high school

   c. Student years of farm experience

   d. Student I.Q.

   e. Economics courses taken by student in high school

   f. Number of teachers in the vocational agriculture department

   g. College quarter hours of economics instruction received by the teacher

   h. Teacher having received Farm Business Planning and Analysis instruction

   i. Teacher having coordinated a Farm Business Planning and Analysis program

   j. Teacher's years of teaching experience

   k. Teacher's attainment of an advanced degree

   l. Hours of instructional time used

   m. Local grades (achieved by student).

3. To determine the effects of the independent variables upon student understanding of each profit-maximizing principle.

4. To conduct teacher evaluation of the developed instructional units of profit-maximizing principles.

Hypotheses

In the development of this study, three major null hypotheses were formulated. They were as follows:

1. There will be no significant difference among the pilot and control schools relative to level of understanding of profit-maximizing principles as measured by a post-test.

2. There will be no relationship between the independent variables and the dependent variable of student understanding of profit-maximizing principles.

3. There will be no effects of the independent variables upon student understanding of each profit-maximizing principle.

Procedures Employed in the Study

The procedures employed in this study were designed to measure the relative effectiveness of newly prepared instructional units. The major steps were: (1) selecting pilot and control schools, (2) orienting teachers with the project, (3) field supervision of participating schools, (4) selecting and administering an evaluative post-test, (5) obtaining teachers' evaluation of the units, and (6) summary and analysis of data.

Careful selection was made of pilot and control schools used to appraise the effectiveness of the developed instructional units. Of 86 Ohio vocational agriculture teachers who indicated an interest in participating in the profit-maximizing principles research project, 22 were selected and randomly assigned to a control or pilot group to complete the instructional unit evaluation. Two hundred sixty-two junior and senior students enrolled in vocational agriculture at these schools completed the post-test. Six of the twenty-two schools acted as controls and taught farm management in the traditional manner. The remaining sixteen institutions were asked to act as pilot schools in using the developed instructional units and to teach them with the inductive process and the discovery approach to learning. Seven of the sixteen schools were assigned as pilot-block to teach from the

units in an uninterrupted sequence of approximately six weeks while the remaining nine schools were designated as pilot-integrated to use the same materials by integrating them with other subject matter during the trial period.

In an attempt to keep the twenty-two participating teachers well-informed of the purpose and status of the study, every effort was extended to continually communicate with them. Once the schools had been selected by mid-July, 1966, the teachers of vocational agriculture were immediately notified by letter. They were asked to obtain specific reference materials and informed of an August 29, 1966 seminar session to further acquaint them with the project. This initial orientation meeting was followed by two local area seminars with pilot teachers designed to specifically acquaint them with the instructional units and the suggested techniques of using them. Individual conferences were later held with all participating teachers throughout the trial period. State supervisors, teacher trainers, school administrative staff, and other persons related to the study were continually informed of the project's status.

A carefully planned and structured program was organized to coordinate the efforts of all participating teachers while they were involved in the study between October 17, 1966, and March 17, 1967. The writer visited each control and pilot school twice during this trial period. The first visit was to observe, the second to administer the post-test to participating students. Evaluation of the instructional units took place continually throughout the trial and testing period. Teachers were asked for their impressions, problems,

student response, use, questions, suggestions, and other comments applicable to unit improvement. All teachers kept this writer informed of their progress through the use of a weekly reporting form. This form was also helpful in evaluating the instructional units.

Student understanding of profit-maximizing principles was measured through the use of an evaluative post-test developed by McCormick.[5] The instrument consisted of 45 multiple-choice questions. It was administered by this researcher at all schools within two weeks after farm management instruction had been completed.

The post-test was the primary method of instructional unit evaluation. However, this means alone did not give a complete description of the ramifications of the instructional innovation. For this reason, pilot teachers who used the principles technique were utilized in obtaining a more precise image of the impact of the units. Teacher subjective appraisal of the units was secured by (1) the writer visiting each pilot school to (a) observe the use of and student response to the units and (b) obtain teacher impressions of the instructional units, (2) the use of a unit evaluative survey instrument, (3) an evaluation meeting with all pilot teachers, and (4) by the previously mentioned weekly reporting forms.

Once all objective data had been secured and compiled, it was taken to the Statistical Laboratory of The Ohio State University. There it was punched into electronic data processing cards and analyzed by the IBM 7094 computer. The F test of analysis of variance

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[5] McCormick, ibid.

followed by the Duncans multiple-range statistic was used to determine the significance of difference among the mean post-test scores achieved by students comprising the three participating groups. Independent variables were grouped by level of measurement and subjected to the Pearson product-moment correlation r, the t and/or the F test to determine their influence upon student understanding of profit-maximizing principles pertaining to all instructional units combined and to each specific principle.

Assumptions

The following assumptions were accepted by this writer as fundamental to this study. It is assumed that:

1. The seven profit-maximizing principles are the central focal point to farm management instruction in vocational agriculture.
2. The instrument used in this study was valid in measuring understanding of profit-maximizing principles.
3. Understanding of profit-maximizing principles can be measured by means of a forced choice evaluative instrument.
4. The criteria used for selecting pilot and control schools utilized in this study provided an adequate randomization.

Limitations

This study was limited by the following factors:

1. The lack of a common understanding of what should be included in farm management instruction for vocational agriculture.
2. The skill of teachers to effectively use the inductive process of the discovery approach to the understanding of profit-maximizing principles.

3. The time and ability of pilot-school teachers to understand and use the developed instructional units as designed in a block or integrated technique.

4. The number and location of the pilot and control schools.

5. The validity and reliability of information received from pilot and control schools pursuant to the independent variables.

Development of the Instructional Units

Need for the strengthening of farm business management instruction in vocational agriculture was recognized in Ohio in 1965. For this reason the writer was commissioned to assist in the development of instructional units designed to teach the understanding of basic economic principles applicable to farm business management. On February 15, 1966, the Departments of Agricultural Education and Agricultural Economics of The Ohio State University endorsed this decision.

Five outstanding teachers of vocational agriculture within the state were employed as technical assistants to aid in the construction of the teaching materials. The format[6] and basic unit development was accomplished by these teachers under the direction of Ralph E. Bender, Department Chairmen, Floyd G. McCormick, and this researcher, of the Department of Agricultural Education, The Ohio State University. The technical assistants completed their

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[6]The format for instructional unit development may be found in the Appendix.

responsibilities by June 1, 1966. Their work was followed by extensive refinement and editing by the research project administrative staff and advisory committee. This work was followed by printing and compiling the instructional units into a teaching manual for use by pilot school teachers. The manuals, containing 145 pages, were completed on August 26, 1966.

The inductive process

Lovenstein[7] indicates that analysis and presentation are of ultimate importance in teaching the understanding of economics. For this reason the inductive approach to learning was used in the design of the new approach to farm business management. "Basically, the inductive process is reasoning from particulars to generalizations. Students all too frequently are not given opportunity for making observations and from them arriving at generalizations. The chief value of the inductive procedure is not that students arrive at 'correct' generalizations consistently, but that they often have the opportunity to employ this type of reasoning under competent direction."[8] Nicholai sees real implications for more in-depth understanding using the inductive process of learning. He furthermore is cognizant of the weaknesses within the present-day classroom setting and of teacher understanding of the inductive process. Many

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[7]Meno Lovenstein et al., "Development of Economic Curricular Materials for Secondary Schools" (The Ohio State University Research Foundation, 1966), p. 21.

[8]F. L. Nicholai, "The Application of Inductive Procedures to Selected Topics for High School Biology," The American Biology Teacher (March, 1961), p. 151.

writers point out these weaknesses. They seem to be in general agreement that the inductive process has many merits but must be used and used well. Teaching inductively avoids rote learning. It concentrates on discovery for oneself under teacher guidance.

> The primary purpose of the inductive process of teaching is to help students find, understand and state principles which have broad application to agriculture and to agricultural practices. Its use also helps students understand why certain farming practices are followed and why other practices are less desirable. It substitutes giving students a more complete understanding of a large important truth for an attempt to give students a transitory knowledge of many less important facts. Therefore, it may accomplish a most desirable end in that its use could result in teaching less and teaching what is taught much more thoroughly.[9]

Sutherland indicates that the inductive process has two major deterrents compared with four compensating advantages. The weaknesses are of a time consumption nature; that of the time required to cover subject matter and that of teacher preparation. The advantages are suggested as (a) being an inherently interesting process, (b) teachers who use it may tend to cover fewer subjects but to teach more thoroughly, (c) the teaching being centered around broad principles with broad application resulting in greater student understanding, and (d) the inductive process being a thinking process whereby students are taught to think.[10]

The discovery approach

Discovery is an integral part of the inductive process. Thus, Bruner combines the interpretations of the majority of the writers in

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[9]S. S. Sutherland, "More Inductive Teaching Needed," The Agricultural Education Magazine (September, 1964), p. 66.

[10]Ibid., p. 71.

stating, "that discovery . . . is in its essence a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence so reassembled to additional new insights."[11] Therefore, if students of vocational agriculture are equipped with experiences and observation of farm management situations and problems they may be guided in the discovery of decision-making. This may, in turn, assist in the understanding of basic profit-maximizing principles with the aid of a principles technique of the discovery approach of teaching. In the discovery approach ". . . we are asking children to think and to generate questions in pursuit of discovery. This requires them to plan, to make decisions and to think creatively."[12] "The success of this procedure depends largely upon the questions asked of the students. Questions should be appropriate and timely. One basic purpose of the questions should be to create problems which students will want to solve."[13] In the design of the developed instructional units, great care was taken in structuring questions to promote student interest and participation.

Most writers agree that discovery in teaching involves a series of experiences and generalizations whereby one comes to understand concepts and principles. Understanding then becomes the basis for

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[11]Jerome S. Bruner, "The Act of Discovery," Harvard Educational Review (Winter, 1961), p. 21.

[12]Richard J. Suchman, "Inquiry Training: Building Skills for Autonomous Discovery," Merrill-Palmer Quarterly of Behavior and Development (July, 1961), p. 156.

[13]Nicholai, op. cit., p. 153.

intrinsic rewards to the individual and leads him toward autonomy. "This dynamic and almost compulsive involvement of the child or adult investigator searching for answers provides the fuel for the vehicle of investigation. Without this hunger for answers there could not be scientific inquiry."[14]

Bruner has suggested that learning by discovery benefits the learner in four major ways. It (a) increases the learner's ability to learn related material, (b) fosters an interest in the activity itself rather than in rewards which may follow from the learning, (c) develops ability to approach problems in a way that will more likely lead to a solution, and (d) tends to make the material that is learned easier to retrieve or reconstruct.[15] In defense of his views, Bruner points out that ". . . the principle problem of human memory is not storage, but retrieval."[16] The key to retrieval is organization and knowing where to find information. Farm management concepts, and principles that are organized in terms of a student's own interests and cognitive structure are truths that have the best chance of being accessible in memory. Thus, teachers of farm management should have available instructional units of profit-maximizing principles that will be helpful in aiding the student in organizing his study to enable him to recall and use basic concepts and principles rather than mere facts.

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[14]Arthur Carin and Robert B. Sund, Discovery Teaching in Science (Columbus, Ohio: Charles E. Merrill Books, Inc., 1966), p. 5.

[15]Bert Y. Kersh, "The Motivation Effect of Learning by Direct Discovery," Journal of Educational Psychology (Vol. 53; No. 2; 1962),

[16]Bruner, op. cit., p. 31.

The inductive teaching process of the discovery approach to understanding of principles is quite adaptable to vocational agriculture. In this age of a wealth of ever-expanding knowledge it is impossible to teach all that is desired of farm management and agricultural economics in the few short years the student spends in vocational agriculture. The Educational Policies Commission recognized this situation in stating, "No school fully achieves any pupil's goals in the relatively short time he spends in the classroom. The school seeks rather to equip the pupil to achieve them for himself."[17] The discovery approach aids in the development of the ability of the individual to become autonomous, and to help develop the heuristics of discovery and learning.

> Economic concepts must not only be "discovered"; they must also be organized. The organization of the concepts can itself be a vital part of the conceptualization of the discipline, a stimulant to effective reasoning and an essential element in the retention of analysis.[18]

Concentrating on basic principles

The discovery approach of inductive teaching and learning leads to basic principles of farm business management. "The experimental course in the principles represents a deliberate and full use of educational philosophy and psychology addressed to three objectives; (a) the demonstration of economic reasoning; (b) the educationally

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[17]Educational Policies Commission, The Central Purpose of American Education (Washington, D.C.: American Association of School Administrators, NEA, 1961), p. 2.

[18]Lovenstein et al., op. cit., p. 24.

meaningful grouping of economic concepts; (c) the use of the logic of economics and rhythmic education as a basis for selection and emphasis."[19] It is, therefore, believed that vocational agricultural instruction should concentrate on the principles approach to farm management if students are to learn more and better. Hammonds states that "in vocational agriculture much attention is being given to principles, concepts, values and other generalizations, and more attention will be given in the future."[20]

The values of concentrating on principles of economics within farm business management are shared by many educators. Due and Clower state that the "relationships which result from economic analysis are economic principles. More specifically, economic principles are generalizations which express relationships among various elements of an economic system."[21] Therefore, if students are to learn to make decisions in farm management they must understand the relationships and basic profit-maximizing principles underlying the economic system of the agricultural business.

Economic principles become the primary tools of farm business analysis and management. This analysis is of primary significance in indicating the consequences of alternative actions within the business and thus provides an intelligent basis for choice among the

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[19] Ibid., pp. 45-46.

[20] Carsie Hammonds, "Teaching Principles, Concepts, and the Like," The Agricultural Education Magazine (January, 1964), p. 123.

[21] John F. Due and Robert W. Clower, Intermediate Economic Analysis (5th Ed.; Homewood, Ill.: Richard D. Irvin, Inc., 1966), p. 12.

alternatives. Furthermore, economic analysis provides a guide to rational planning. Given the desired goals of the individual farm business, the utilization of economic principles allows an evaluation of various policies for efficient attainment of the goals. "Application of economic principles to existing circumstances should facilitate improved estimates of future decisions. . . . The utilization of economic principles to analyze the facts of the particular situation provides the best available basis for prediction and decision making."[22]

The principles approach to farm management helps the student to understand the "why" involved in the decision-making process. Mickelson states, "that a person who learns the simple <u>what</u> and <u>how</u> of a skilled situation without the basic principle of <u>why</u> is extremely limited educationally."[23] Students who are taught the understanding of basic principles have a better understanding of the given situation in that it is more meaningful when he has the ability to recognize it as such and to transfer these factors in a useful manner. ". . . basic principles produce results over and over again; therefore, they become the essential foundation of education in agriculture and constitute the basis for making sound decisions and for the application of skills and techniques."[24]

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[22] <u>Ibid</u>., p. 18.

[23] L. F. Michelson, "Teaching Basic Principles--A Definition," <u>The Agricultural Education Magazine</u> (March, 1965), p. 225.

[24] C. E. Richard, "Teaching Basic Principles in Science in the Vocational Agricultural Curriculum," <u>The Agricultural Education Magazine</u> (January, 1964), p. 130.

Learning principles per se is of no value. Formulating the profit-maximizing principles in words is not indispensable in achieving application because the generalization, meaning, and usefulness is not achieved. Craig adds that through the discovery method "independently derived principles are more transferrable than those where the principle is given to the student."[25] In other words, the high school student of farm management must discover the similarity of the situations and derive the principle from them.

In designing a manual for integrating biological principles into agriculture researchers in California stated that

> The principles approach was selected because it lends itself to instruction for understanding, essential to the ability to make appropriate applications.
> . . . It has long been accepted that "principles should be taught with application"; that teaching is most effective when these two important kinds of content are presented in the closest association with each other.[26]

It is in this same reference that instructional units were developed for teaching profit-maximizing principles at The Ohio State University in 1966.

Farm management is concerned with decision-making. As new techniques are developed, the farm manager must make more and more decisions based on economics. "The skillful manager strives to make those decisions which will maximize the returns to all resources used in the farm business insofar as they are constant with personal

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[25]Robert C. Craig, "Directed Versus Independent Discovery of Established Relations," Journal of Educational Psychology (April, 1954), p. 224.

[26]California State Department of Education, Biological Principles in Agriculture, A Report of a Project Consultant Under the National Defense Education Act of 1958, p. i.

objectives. This involves the use of the principles of economics in connection with laws which govern the growth of plants and animals, and the use of labor and machines."[27] The instructional units developed of profit-maximizing principles concentrated on this expanding decision-making process.

Evaluation

For students of vocational agriculture to become efficient farm and/or firm entrepreneures they must be well-trained on the understanding of basic profit-maximizing principles. This study concerns itself with the appraisal of the previously mentioned instructional units designed to enhance student understanding of profit-maximizing principles. It is imperative that these units be tested and validated to measure their effectiveness before they are distributed and used by other teachers of agriculture. Therefore, this study determined the over-all effectiveness of three techniques of farm management instruction and its relationship to independent variables. Without a planned and structured evaluation, little would be known of the influence of the independent variables and technique of instruction upon student understanding of profit-maximizing principles. The goal of the developed instructional units was to enhance understanding of profit-maximizing principles. Evaluation, on the other hand, is the comparison of the actual with the ideal. Without evaluation it would be uncertain as to the attainment of the ideal or the foregoing goal.

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[27] H. C. M. Case, Paul E. Johnson, Wilbur D. Buddemeier, Principles of Farm Management (Chicago: J. P. Lippincott Co., 1960), p. 57.

Apprasial should show evidence of the influence of inductive teaching using discovery approach and the principles technique to farm management instruction.

Appraisal of the developed instructional units was comprehensive in the attempt to measure their effectiveness. The primary emphasis in evaluation was accomplished through the efforts of students and pilot school teachers. A post-test administered to all students in both pilot and control schools established a measure of level of understanding of the profit-maximizing principles which was used for comparing the three techniques of farm management instruction. Student test scores were complemented by teacher appraisal of the units which was achieved by (1) the writer visiting each pilot school to (a) observe the use of and student response to the units and (b) obtain teacher impressions of the instructional units, (2) the use of a unit evaluative survey instrument, (3) an evaluation meeting with all pilot teachers, and (4) by weekly reports from teachers on "Daily Schedule of Activities" sheets.

Definition of terms

1. Profit-maximizing principle: A generalized statement, assumed to be true, which provides an accepted guideline to sound decision-making which affects the profitability of the farm business. Economic principle, as used in this report, is synonymous with the above definition.

2. Principle: A fundamental truth. A law of conduct which has general application, and which is a basis for action. It is a

generalization based upon facts and upon elements of "likeness" common in a number of situations.

3. Inductive teaching and learning: This process involves going from the concrete to the abstract. Instruction starts not with a statement of the principle but with observed or described situations which illustrate the principle and which should lead students eventually to discover and state it with the assistance of the teacher. Inductive thinking generally begins with observed effects and leads eventually to the cause or causes.

4. Pilot school: A school used in this study where the teacher of vocational agriculture used instructional units prepared for teaching profit-maximizing principles. Pilot-block were those schools who used the materials in an uninterrupted sequence of time. Pilot-integrated were those schools using the materials by integrating them with other subject matter, generally over a longer period of time.

5. Control school: A school used in this study in which no attempt was made to deviate from the traditional program of farm management instruction. These schools were used for comparison purposes only.

6. Traditional manner of teaching farm management: This is the technique generally used by Ohio teachers of agriculture in teaching farm management to students of vocational agriculture. Typically it is taught to juniors and/or seniors in a classroom situation using the lecture and discussion methods. Farm analysis, problems, record keeping, finance, and management of enterprises are usually covered using a wide range of instructional time. Text material often used

by teachers includes (1) student project account books, (2) Doane's Farm Management Guide, (3) Profitable Farm Management by Hamilton and Bryant, and (4) miscellaneous bulletins and brochures.

7. Technique of instruction: This term refers to the method of instruction, i.e., pilot-block, pilot-integrated, or control.

8. Level of understanding: A concept developed to express the extent of knowledge of basic economic principles possessed by students within the sample as measured by a post-test.

9. Participating teacher and/or school: A pilot or control teacher and/or high school in the State of Ohio cooperating in the trial use of the developed instructional units of profit-maximizing principles or teaching farm management by the traditional technique.

10. Instructional units, units, developed units, or units of profit-maximizing principles: Terms used to describe teaching units which were the basis of this study. They consisted of seven sections or individual units, each dealing with a specific economic principle and bound in a manual entitled, "Instructional Units on Profit-Maximizing Principles."

Major Findings

Major findings derived from the analysis of data collected through this study are listed below. They are grouped according to the major emphasis used in the pursuit of instructional unit evaluation.

Technique of instruction resulting in the greatest level of student understanding of profit-maximizing principles

The pilot-block group of students involved in this study obtained the highest score on the post-test which measured the understanding of profit-maximizing principles. This group was followed in sequence by the pilot-integrated and control groups. From Table 1 it can be noted that respective scores were 61.3, 58.4, and 54.0, with an average of 58.0 for all schools combined. Statistically this difference in total post-test scores is significant above the .05 level of confidence indicating that the instructional units taught by the pilot-block technique were superior to either the pilot-integrated or the traditional techniques. It further indicates that the pilot-integrated technique enhanced student understanding of profit-maximizing principles to a greater extent than did the traditional technique.

Test scores received by students concerning each of the profit-maximizing principles as shown in Table 1 reveal a similar outcome as did the total test score concerning all seven units. The pilot-block group excelled the other two groups on units 1, 2, 3, 4, and 6. Control and pilot-integrated groups obtained the highest scores on one unit each. These were units 7 and 5, respectively. The control group achieved the lowest score on five units while the pilot-integrated obtained second rating on the same quantity.

Because of the results obtained in this study, the null hypothesis was rejected which stated that there would be no

significant difference among the pilot and control schools relative to level of understanding of profit-maximizing principles.

TABLE 1

COMPARISON OF MEAN POST-TEST SCORES IN TOTAL AND FOR EACH INSTRUCTIONAL UNIT

Profit-Maximizing Principle	Percentage of Correct Responses Selected			
	Control (n=77)	Pilot-Block (n=77)	Pilot-Integrated (n=108)	All Schools (n=262)
All units combined	54.0	61.3	58.4	58.0
Unit 1 (Diminishing Physical Returns)	58.4	68.4	65.1	64.1
Unit 2 (Diminishing Economic Returns)	50.0	62.3	57.1	56.6
Unit 3 (Fixed-Variable Costs)	54.0	61.6	56.6	57.3
Unit 4 (Substitution)	52.7	64.7	60.7	59.5
Unit 5 (Opportunity Costs)	43.0	51.6	52.0	49.2
Unit 6 (Combination of Enterprises)	53.3	57.2	55.7	55.4
Unit 7 (Time Relationships)	68.4	64.7	63.3	65.2

Relationship between student understanding of profit-maximizing principles and the independent variables

Of the thirteen independent variables, four proved not to be significantly related to student post-test scores.

These independent variables were:

1. Student year in high school.
2. Economic courses taken by students in high school.
3. Teachers having received Farm Business Planning and Analysis instruction.
4. Teachers having coordinated a Farm Business Planning and Analysis program.

Three independent variables showed a very minor degree of relationship with post-test scores. In each case only one group of students of the three within the study proved to be significant at the .05 level of confidence. These factors would tend not to be reliable in predicting post-test scores. The independent variables in this classification were:

1. College quarter hours of economics instruction received by the teachers.
2. Hours of instructional time used.
3. Local grades.

The six remaining independent variables tended to be more closely associated with total post-test scores achieved by participating students. However, these factors present only a low degree of relationship. They were:

1. Student year in vocational agriculture.
2. Student years of farm experience.

3. Student I.Q.

4. Number of teachers in the vocational agriculture department.

5. Teacher's years of teaching experience.

6. Teacher's attainment of an advanced degree.

The first four items had a positive relationship with student understanding of profit-maximizing principles. The latter two were found to have an inverse relationship with student understanding.

The null hypothesis was rejected due to the findings of this study. It stated that there would be no relationship between the independent variables and student understanding of profit-maximizing principles.

The effects of independent variables upon student understanding of each profit-maximizing principle

Analysis of the effects of the independent variables upon student understanding of individual profit-maximizing principles revealed similar results as were found when total post-test scores were compared with each independent variable.

Of the thirteen independent variables, six proved to be statistically non-significant in association with student test scores on individual instructional units. The six were:

1. Student year in high school.

2. Economics courses taken by students in high school.

3. College quarter hours of economics instruction received by the teacher.

4. Teachers having received Farm Business Planning and Analysis instruction.

5. Teachers having coordinated a Farm Business Planning and Analysis program.

6. Hours of instructional time used.

Two independent variables showed very minor negative relationship. In both cases significant values were only sporadic. These two factors were:

1. Teacher's years of teaching experience.

2. Teacher's attainment of an advanced degree.

The remaining five independent variables displayed a greater degree of association with test scores concerning specific instructional units. It is noted, however, that influence from these factors was relatively low. They were:

1. Student year in vocational agriculture.

2. Student years of farm experience.

3. Student I.Q.

4. Number of teachers in vocational agriculture department.

5. Local grades.

It was hypothesized that there would be no effects of the independent variables upon student understanding of each profit-maximizing principle. Since some association was found between the two factors, the null hypothesis was rejected.

Composite association of independent variables with student understanding of profit-maximizing principles

Results obtained in achieving objectives two and three of the study demonstrated the association of thirteen independent variables

with student understanding of profit-maximizing principles. Objective two was concerned with total post-test scores covering all instructional units whereas objective three dealt with test scores achieved on specific questions pertaining only to individual instructional units. Table 2 depicts the degrees of association of the independent variables with student understanding of profit-maximizing principles.

TABLE 2

DEGREES OF ASSOCIATION OF INDEPENDENT VARIABLES WITH STUDENT UNDERSTANDING OF PROFIT-MAXIMIZING PRINCIPLES

Independent Variable	None		Minor		Some	
	All Units	Individual Units	All Units	Individual Units	All Units	Individual Units
1. Student year in vocational agriculture					x	x
2. Student year in high school	x	x				
3. Student years of farm experience					x	x
4. Student I.Q.					x	x
5. Economics courses taken by students in high school	x	x				
6. Number of teachers in Vo-Ag department					x	x

TABLE 2--Continued

Independent Variable	None		Minor		Some	
	All Units	Individual Units	All Units	Individual Units	All Units	Individual Units
7. College quarter hours of economics instruction received by the teacher		x	x			
8. Teacher having received Farm Business Planning and Analysis instruction	x	x				
9. Teacher having coordinated a Farm Business Planning and Analysis Program	x	x				
10. Teacher's years of teaching experience					x	x[a]
11. Teacher's attainment of an advanced degree					x	x[a]
12. Hours of instructional time used		x	x			
13. Local grades			x			x

[a]Demonstrated a negative influence.

Degrees of association are categorized by (a) none, (b) minor, and (c) some. Only in a few instances were independent variables considered to have more than a slight relationship with student understanding. For this reason there was no need to include a category for

more than "some" association. It is noted that four independent variables (2, 5, 8, and 9) had no association with student understanding of profit-maximizing principles with all units combined or when individual units were analyzed separately. Likewise, four independent variables (1, 3, 4, and 6) having some degree of relationship, were consistent throughout both analyses. However, there were five independent variables (7, 10, 11, 12, and 13) that showed inconsistent minor association with student understanding. While some shifted to no association upon close examination of the relationship with individual unit test scores, others tended to be more significant. Differences in numbers of students dealt with and the inconsistency among teachers and schools appeared to cause this relationship.

Teacher evaluation of instructional units

Teacher evaluation of the instructional units was found to be helpful in appraising the worth of the units and the discovery approach of the inductive process to learning profit-maximizing principles.

Results from the four evaluation methods proved to be similar. Generally, pilot teachers were strongly in favor of the units; feeling that the profit-maximizing principles approach to farm management was a move in the direction of improving this vital phase of the vocational agriculture curriculum. They found the new technique of teaching a challenging and time-consuming task. It required extra study and effort on the teacher's part, but once he had set forth the extra preparation and teaching time and effort, students seemed

to respond with renewed interest. There remained throughout the study some confusion, indecision, and disagreement among teachers as to their impressions of the units. Teachers agreed that the units should be used in vocational agriculture and that they would personally use the material again.

Conclusions

The following conclusions were drawn by the investigator, based on his interpretation of the data and information presented in this study:

1. The developed instructional units enhanced student understanding of profit-maximizing principles to a greater degree than did the traditional technique of teaching farm management used by control schools.
2. When teachers of vocational agriculture used the developed units in an uninterrupted block of instructional time, students showed a greater understanding of profit-maximizing principles than did students whose teachers used the pilot-integrated technique of teaching farm management from the units.
3. Student understanding of profit-maximizing principles was slightly influenced positively by the association of four independent variables as investigated through this study. They were:
   a. Student year in vocational agriculture.
   b. Student years of farm experience.

c. Student I.Q.

d. Number of teachers in the vocational agriculture department.

4. Teachers who appeared to have the greatest appreciation of profit-maximizing principles, the developed instructional units, and the discovery method of teaching, tended to more effectively employ the new technique of farm management instruction in classes of vocational agriculture.

5. Teachers who used the instructional units believed that the profit-maximizing principles approach to farm management instruction in vocational agriculture greatly strengthened this vital phase of the vocational agriculture curriculum.

6. Pilot teachers found the instructional units challenging, time-consuming, and requiring extra study, yet this extra preparation and teaching efforts tended to result in greater student interest and achievement.

Recommendations

As a result of the findings of this study and the experiences of the writer, the following recommendations are made:

1. That the profit-maximizing principles approach be continued and extended into greater numbers of vocational agriculture departments.

2. That in-service education programs be offered to teachers of vocational agriculture to further

acquaint them with the profit-maximizing principles, the instructional units, and the discovery method of teaching.

3. That state vocational agriculture staffs provide assistance to teachers in planning and organizing local farm management instruction to effectively include the instructional units.
4. That prospective teachers of vocational agriculture be given experience in using the profit-maximizing principles and the instructional units during undergraduate study and student teaching.
5. That greater emphasis be placed on the use of the discovery method and the inductive process in teaching and learning the profit-maximizing principles when using the instructional units in local vocational agriculture departments.
6. That a continuous effort be made by teachers to assure a vocational education approach when using the instructional units by relating them to the students' agricultural interests.
7. That further attention be given to the development of instructional units concerning basic principles in other areas of the vocational agriculture curriculum.

Recommendations for Further Study

In the pursuit of this study, the writer became aware of the need for continued research. He suggests that:

1. The instructional units be revised to include recommendations of teacher trainers, state supervisors, and teachers who used the materials and according to the findings of this study.
2. This study be repeated using a larger sample selected at random throughout the State of Ohio.
3. The revised instructional units be used by teachers of vocational agriculture in several states to determine their appropriateness in strengthening farm management instruction in various regions of the country.
4. A follow-up study be made of students who receive farm management instruction by the principles technique to determine the application made of the profit-maximizing principles.
5. Study be made of vocational agriculture teachers to determine the technical and professional training needed to effectively teach the understanding of profit-maximizing principles by the discovery method.
6. Replication of this study be made using teachers who have experienced the use of the instructional units

and an equal number of teachers who have not, to determine the values of familiarity with the profit-maximizing principles, the instructional units, and the discovery method of teaching.

APPENDIX

FORMAT FOR DEVELOPING INSTRUCTIONAL UNITS

I. Profit-Maximizing Principle Unit Title

II. Unit Objectives

III. Introduction

a. Techniques for introducing units.

IV. Teaching - Learning Activities (Educational Experiences)

a. Based upon presentation of real examples.

b. Technical information incorporated in this section.

V. Association of Examples

a. Objective of this section - arrive at generalizations.

VI. Arriving at Principle based upon above generalizations

VII. Activities for students to use in applying understanding of identified principle

VIII. Source References

POST-TEST SCORES FOR ALL PARTICIPATING SCHOOLS

School No.	No. of Students	Post-Test Scores
Control:		
1	5	63.6
2	17	49.5
3	12	50.7
4	20	58.7
5	7	50.5
6	16	53.8
Sub-Total	77	54.0
Pilot-Block:		
7	12	59.1
8	7	62.9
9	19	56.3
10	11	60.6
11	11	57.6
12	13	75.4
13	4	56.7
Sub-Total	77	61.3
Pilot-Integrated:		
14	14	50.6
15	14	68.1
16	9	57.8
17	8	39.4
18	10	53.1
19	15	66.4
20	11	45.5
21	7	64.4
22	20	67.1
Sub-Total	108	58.4
Grand Total	262	58.0

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